

Uva Wellassa University, Sri Lanka  
End Semester Examination – June 2009  
ENG 308-1 Applied Thermodynamics



Time: One (01) hour

Total 04 questions

Answer all questions

Clearly state any assumptions made

You can assume any missing data

Tables of properties are provided in the exam hall

09-308-ENG 308-1

- 01) A steam power plant receives heat from a furnace at a rate of 280 GJ/h. Heat losses to the surrounding air from the steam as it passes through the pipes and other components are estimated to be about 8 GJ/h. If the waste heat is transferred to the cooling water at a rate of 145 GJ/h, determine
- I. net power output. (10 marks)
  - II. the thermal efficiency of this power plant. (10 marks)
- 02) An air-standard cycle is executed in a closed system and is composed of the following four processes:
- 1-2 Isentropic compression from 100 kPa and 27°C to 1 MPa
  - 2-3  $P = \text{constant}$  heat addition in amount of 2200 kJ/kg
  - 3-4  $v = \text{constant}$  heat rejection to 100 kPa
  - 4-1  $P = \text{constant}$  heat rejection to initial state
- I. Show the cycle on  $P - v$  and  $T - s$  diagrams. (10 marks)
  - II. Calculate the maximum temperature in the cycle. (10 marks)
  - III. Determine the thermal efficiency. (10 marks)
- Assume constant specific heats at room temperature.

- 03) A steady-flow Carnot refrigeration cycle uses refrigeration-134a as the working fluid. The refrigerant changes from saturated vapour to saturated liquid at  $30^{\circ}\text{C}$  in the condenser as it rejects heat. The evaporator pressure is 120 kPa.
- I. Show the cycle on a T-s diagram relative to saturation lines. (05 marks)
  - II. Determine the coefficient of performance. (05 marks)
  - III. Calculate the amount of heat absorbed from the refrigerated space. (05 marks)
  - IV. Calculate the net work input. (05 marks)
- 04) A steam power plant operates on an ideal regenerative Rankine cycle with two open feed water heaters. Steam enters the turbine at 10 MPa and  $600^{\circ}\text{C}$  and exhausts to the condenser at 5 kPa. Steam is extracted from the turbine at 0.6 and 0.2 MPa. Water leaves both feed water heaters as a saturated liquid. The mass flow rate of the steam through the boiler is 27 kg/s.
- I. Show the cycle on a T - s diagram. (10 marks)
  - II. Determine the net power output of the power plant. (10 marks)
  - III. Determine thermal efficiency of the cycle. (10 marks)